1892-1992

100 Years
of
IUFRO

International Union of
Forestry Research Organizations

The Beginnings

These men in frock coats, whom we see in the above picture taken in September 1891, were participants in an excursion to experimental plots in Switzerland. They were all outstanding personalities representing forest research in Central Europe. It was after this excursion that they met in the South German health resort of Badenweiler, well–known at the turn of the century, on the occasion of the annual conference of the Association of German Forest Experiment Stations. There a group of them developed the statutes which, in the following year, led to the founding of the International Union of Forest Experiment Stations.

The idea of international cooperation in forestry was not new. Already the great floods which haunted Central Europe in the second half of the 19th century had given rise to a call for an international forest protection law. It was necessary to combat the problem at its roots, in the mountainous regions where large cuttings had substantially reduced the forest stands and where the soil could not retain the huge volumes of water brought by sudden cloudbursts.

Although the legislative aspirations were not attained, extensive forest meteorology studies were conducted, bringing about close cooperation between the responsible scientists and their colleagues in other countries. Another subject which promoted lively international exchange of views at the time was the influence of the forest on climate.

International congresses

Contacts between the scientists remained mostly loose and by chance. The most important meeting places, apart from the universities, were international agricultural and forestry-related congresses. These were usually combined with exhibitions where forest scientists presented their latest findings, where they discussed relevant matters in the "forestry section", and where scientists who had known each other only from the literature met personally.

In the course of time, as forest research advanced, this forum tended to be too general and to address an audience having too varied interests. In most cases the topics were so general in nature and participation was so haphazard that forest scientists who were interested in specific problems could rarely get ideas from colleagues for well-defined research projects.

Applied forest research

While forest science at universities could profit from traditional means of knowledge and experience exchange, the new branch of applied forest research had no appropriate forum. These forest researchers worked mainly in the field and participation in congresses was not sufficient. Field study tours to experimental plots were also necessary for their work.

An alternative to the missing international scientific forum was the annual conference of the Association of German Forest Experiment Stations, to which representatives of neighbouring countries were invited also as observers. But even this kind of meeting and information exchange proved to be insufficient. On the one hand, the observer status was unsatisfactory in the long run. On the other, it was not only exchange of information that was becoming increasingly necessary but also cooperation in actual project work.

Old and New Forest Academy, Eberswalde, Germany

The forest experiment stations were in close touch, mostly with the forest faculties of the universities in their own country, and sometimes coordinated their research work with each other. From an international point of view they carried out similar projects, but mostly without any coordination and using different research methods. There was much unnecessary duplication of work and, what was even worse, it was often not possible to compare the results.

The founding of IUFRO

IUFRO's birthplace

In 1890, during the Congress of Agriculture and Forestry in Vienna, a proposal was made to create a "central organ" for applied forest research in the European countries. However, the proposal was far from the idea of an efficient organization operating in accordance with harmonized rules and standardization of research methods for its members. The real need was a forum in which researchers could discuss their plans, methods, results and instruments and advise each other.

A proposal was put forward by K. Böhmerle of Austria in which the forest experiment stations of all European countries were invited to cooperate. Statutes were developed for an international union and the representatives of the experiment stations asked their respective governments to give their consent to membership. However, this was more difficult than had been expected.

At the time, forest experiment stations existed in Austria, Belgium, Denmark, France, Germany (eight stations), Hungary and Switzerland, but only three governments agreed that their stations could join the proposed union. Thus on August 17, 1892 in Eberswalde, Germany the International Union of Forest Experiment Organizations was founded by three members only: the Association of German Forest Experiment Stations and the experiment stations of Austria and Switzerland. The representatives of France and Hungary, who had contributed considerably to the preparatory work, as well as the representatives of Belgium and Denmark, were missing at the founding assembly.

In the years to the turn-of-the-century, the national forest administration of Spain became a member and the international meetings of the Union brought together delegates from Belgium, France, Hungary, Italy, Japan, Russia and Sweden.

In 1903, a modification of the statutes was made in order to provide the possibility of "corresponding membership". The number of members then rose quickly: Belgium, Denmark, England, Hungary, Italy, Japan, Norway, Russia (1903); Bulgaria, USA (1906); Canada, The Netherlands, Portugal, Romania, Serbia, Sweden (1910). Further enlargement was interrupted by the First World War.

Forest and water

Drought, drying up of water sources, floods in lowland areas and suddenly rising torrents in the mountains have troubled mankind for centuries. Foresters had begun to concern themselves with the influence of forests on water balance during the middle of the 19th century and such matters were the main topics of IUFRO work in the period before World War I.

During the second IUFRO Congress in 1896 a committee was formed to tackle these questions. It was one of the first working units and was active between the congresses. As part of the division of work, the Prussian experiment station installed one hundred rain gauges in six forest areas of more than 3,000 ha each. Precipitation in the forest could be compared with

Temperature measurements in a forest stand, Switzerland, 1903

that on bordering open land by means of these gauges. For more than 40 years researchers had been working on the effects forests have on levels of precipitation. Understanding of this subject was considered prerequisite to the investigation of the occurrence of springs, soil humidity and evaporation, surface runoff, and groundwater flow.

The other experiment stations made special forest meteorology observations such as measurements of temperature in the stand and of the

Rainfall measurements under a canopy, Austria, 1902

quantity of rainfall received by tree crowns, compared to the quantity which actually reached the ground. The influence of tree species, nature, age and density of the stand had to be determined.

The Swiss experiment station started runoff measurements in the mountains (Emmental Valley), with the aim of finding evidence for "the reduction of drain water by the forest in case of heavy rainfall". For the first time forest researchers wanted to not just confirm known information, but to find out the reasons for forest phenomena. The observations in the Emmental Valley have been continued to the present.

All these experiments were extremely difficult to carry out. Despite expensive investigations it was not possible to arrive at conclusions which could be generalized; they were only of an orientation nature or of very narrow applicability. Due to the "eminent importance" of these investigations, as they were described in the Congress proceedings, they were included on the agenda of all congresses.

Provenance trials

By the second half of the 19th century, forest practitioners had recognized the importance of provenance for the performance of trees and had initiated provenance trials. Such trials are of long duration and many were forgotten since it depended on the interest of the initiator's successor in the respective forest district whether their maintenance was continued. The experiment stations felt the need to take over this long–term task in order to give forest practitioners a sound basis for the planting of certain tree species.
The main questions to address were:

a) whether a tree species at the limits of its natural range will adapt to extreme climatic conditions, e.g., will it be frost–resistant or susceptible to frost damage;
b) whether a tree species is able to adapt itself to the climate outside its natural range;
c) whether and to what an extent such adaptation, if it occurs, will be inherited by the tree's progeny;
d) whether a tree species will transmit favourable or unfavourable traits gained as a result of new conditions or through treatment and, if so, whether such transmittal will take place in the first generation or later.

At the 1900 Congress, the IUFRO members decided to establish provenance trials with pine, larch, spruce and oak in their respective countries. A commission developed a plan with detailed instructions concerning choice of seed trees, handling of seeds, and method of planting.

Seed trees from the following regions and sites were to be selected:
spruce: natural seeding; from natural habitats, various altitudes, various growth areas;

Alpine experimental plot at 1,400 m a.s.l., Austria, around 1900

pine: from regions close to the tree line; northern Sweden, northern Norway, northern Finland, northern German plain, Baltic Regions, valleys of the Main and Rhine rivers in Germany;
larch: from different altitudes in the Alps, Sudeten Mountains, Siberia or northeastern Russia;
oak: "seeds from different provenances", among them typical frost localities.
Stands were to be established at different altitudes. Some of these experimental plots can still be visited today.

Exotic tree species

By the end of the 18th century various introduction trials with exotic

Douglas fir trial, Switzerland, 1925

tree species existed in Germany. The results were disappointing, however, and were discontinued for more than a century. England fared much better. By the end of the 19th century more than 100 conifer species had been planted with much success. During the 1880s, the experiment stations of continental Europe assumed this task, emphasizing the silvical characteristics of the tree species. Two approaches offered themselves: first, to study "exotic" tree species, mainly American and Japanese, in their natural range; second, to conduct lengthy field trials in the countries in which they were introduced. The 1903 Congress recommended the second approach and drew up special work plans for all regions having a distinct climate.

International agreement on seed material

In his provenance trials, the Austrian A. Cieslar focused on the importance and influences of site, especially of altitudinal zones, on the growth characteristics of plants. At the 1893 Congress in Vienna he pointed out that most private seed dealers did not know the source of the material they were selling. Therefore, Cieslar said, good growth results were often merely accidental, even if the seed was of good quality. Based on these considerations, he proposed to found private "forest seed cooperatives" across Europe which would harvest seeds in accordance with harmonized rules so that their members could be assured of receiving material suited to site. Predictions of harvest would be published annually for Central Europe, Sweden, Norway and Russia. The proposal was rejected, first, because only "scientific" and not administrative matters should be tackled by the Union; second, because at that time forest scientists in Germany did not assign great importance to altitudinal differences.

Conversion of pure stands to mixed stands

Before the First World War, the superiority of mixed stands over pure stands was almost dogma. However, thorough investigations to verify this assumption had never been carried out. For forest practitioners the short rotation periods and simpler management of pure stands were deciding factors and guaranteed quick success. At the 1910 Congress, the delegate from Belgium advocated mixed stands (for which he predicted a brighter future than for pure stands) by presenting a proposal for the conversion of spruce monocultures to mixed stands.

Mixed stand, Switzerland, 1921

Thinning and incremental felling trials

Questions of stand tending were central among the tasks of experiment stations. In Central Europe they worked in accordance with a plan laid down in 1873 by the Association of German Forest Experiment Stations.

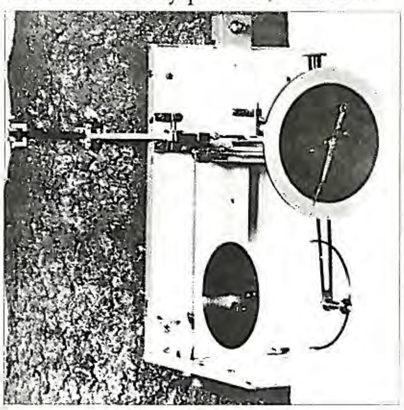
At the 1900 IUFRO Congress the need to revise this work plan was discussed. At the following congress, in 1903, the delegates agreed on the publication of a "Guide for thinning and incremental felling trials", based on a joint German–Austrian proposal, which showed the way for the next half century. The leading personality in the preparation of this guide was A. Schwappach (the self–confident gentleman in the picture on page 2, foreground, right hand side, holding a walking stick in his hand). (The second "Prussian" in this picture can also be identified by his walking stick. He is B. Danckelmann, director of the Forest Experiment Station of Eberswalde.)

Experimental plot, Kiriyama, Japan

An experimental plot established in accordance with the "Guide for thinning and incremental felling trials" can be seen in the picture above. This trial was initiated in Japan in 1913. The picture was taken in 1981 on the occasion of the IUFRO World Congress in Kyoto.

Increment and weather

On account of their great importance for forestry practice, the influences of site, tree species and silvicultural management method on rate of tree growth had been often and thoroughly investigated. A researcher who investigated mainly the influence of weather on tree increment was J. Friedrich from Vienna. He made his measurements by means of a specially constructed "auto-graph", which he demonstrated during the IUFRO Congress in Switzerland in 1900. By means of this instrument it would be possible to find out whether, and for how long within a vegetative period, differences in increment occurred, and whether this was related to weather conditions. In addition, it was hoped to determine why the girth of trees decreased periodically. The Congress delegates showed great interest in this subject. The congress of 1900 may be considered the starting point of growth increment research on individual trees.



Increment "auto-graph" by J. Friedrich, Austria, 1905

Forestry bibliographies

Unlike other sciences, forestry had no special bibliographies. The only survey of new publications was provided by booksellers' annual catalogues. For German–speaking countries there was also the annual supplement to the "Allgemeine Forst- und Jagdzeitung" (General Forest and Hunting Journal). But these aids were insufficient and so, in 1903, a proposal was submitted to the Congress to create an international bibliographic centre for forestry. An institute in Zürich which had specialized in zoology and anatomy and an institute in Brussels which covered social sciences served as models. A novelty was that the data were no longer printed in the form of books but written on index cards which were copied to the members. In addition, the literature was not only filed by keywords but, as in the Bibliographic Institute in Zürich, in accordance with the strict form of a decimal classification system.

Technical properties of wood

Most experiment stations, in co-operation with technical universities, studied the properties of wood. In this field of research also it was necessary to develop standardized rules in order to make results comparable. The 1900 Congress agreed on a work programme which included regulations for sampling, marking and testing.

Material testing machine, around 1900

Properties investigated were, among others, elasticity, strength and hardness of woods, their suitability for construction, impregnation methods, impacts of fresh- and saltwater, fungus resistance in water, bleeding, and the suitability of beech as a road surfacing material.

Between the World Wars

The 7th IUFRO Congress was being organized in Hungary for September 1914. The preparatory work had been completed and the papers and excursion guides printed when general mobilization made further cooperation impossible. IUFRO's work had been halted by the First World War.

It was not until 1926, on the occasion of the First World Forestry Congress in Rome, that forest scientists were able to meet again in international forum. Immediately after the Congress, representatives of the experiment stations of Denmark, France, Germany, Norway, Sweden and Switzerland met in Zürich where they decided to revive IUFRO. The director of the Swedish experiment station, H. Hesselmann, was entrusted with the organization of the next IUFRO congress, planned for 1929. Beside the technical sessions a main agenda item was the preparation of clear and simple statutes.

The Union then became more open towards scientific problems and membership. Not only experiment stations, but also universities, forestry education centres, and other forestry institutions gathered in IUFRO. The name "International Union of Forest Experiment Stations" was changed to "International Union of Forestry Research Organizations". New members joined the Union which gradually lost its Central European character. Scandinavian and North American member organizations were equally involved in shaping the work programme of the Union and, for the first time, representatives from experiment stations in the then colonies in Africa, Asia and South America were able to bring forward and discuss their forestry problems.

Because of this expansion, a new structure was developed for the Union. Whereas before the war the only organs of the Union were the Congress (assembly of members) and the President, now every member country appointed a representative to an International Committee. In the period between two successive congresses, a Permanent Committee of seven persons coordinated the activities in cooperation with the President. Secretary–General S. Petrini was in charge of the daily work. In addition there were several subject matter–related sections.

Congress work

The new character of the Union became obvious at the 1929 Congress in Stockholm. Whereas the 1910 Congress had been attended by not more than 30 members and observers and only ten papers (followed by discussion) were read to the plenum, the 1929 Congress brought together a total of 205 participants from 31 countries; 105 papers were read in plenary meetings and in meetings of the four sections on themes such as forest ecology, forest soil science, forest entomology and general forestry. The 1932 Congress in France enlarged the range of themes by including tropical and Mediterranean forestry, forest utilization, forest protection, afforestation, and forest site. The 1936 Congress in Hungary added forest management planning.

International seed exchange

Unlike agriculture, and despite earlier initiatives, forestry had paid little attention to the importance of provenance. The lack became obvious when forest practitioners increasingly required vigorous plants and tree species well adapted to site. The 1926 World Forestry Congress in Rome suggested that forest experiment stations include forest genetics in their work programmes and carry out further experiments on different provenances of tree species. The idea was well received, and at the IUFRO Congress in Stockholm in 1929 first steps towards an international seed exchange programme were taken. The seeds would be collected and handled in the respective countries in accordance with standardized rules, and the results of experiments should be comparable.

Another suggestion of the 1926 World Forestry Congress was also accepted, i.e., to establish a centre for forest seed exchange. The task was assigned to the Secretariat in Stockholm. The exchange was lively, even during the Second World War when international contacts were cut and IUFRO was reduced to just its Secretariat in Sweden. The annual report for 1943 states that the collection of

Larch provenance trial 1944, Italy

seeds for international larch provenance trials in Germany, Switzerland, Italy, Denmark, Finland, Poland, Czechoslovakia, Sweden and Scotland had been completed and that interested members "had already been asked in May to submit their orders". It was promised that seed material would be mailed in the spring of 1944, which was done in time that planned trials could be set out (see page 12).

Site description

In 1908 A. Schwappach presented his epoch–making "Guide for site and stand description" to the Association of German Forest Experiment Stations. Rapid progress in research made a revision necessary and in 1929 an international committee was entrusted with this task: K. Kvapil and J. Konsel (Czechoslovakia) developed a proposal for the Central European countries. The future IUFRO President A. Pavari (Italy) did so for the Mediterranean countries and scientists from the forest institute in Dehra Dun (India) declared their readiness to prepare an instruction guide for tropical countries. After repeated discussions the committee presented a 58–page scheme for site description for the three areas in 1936.

Humus forms

Almost every great forest scientist had worked on forest humus, as the transformation of organic matter into humic material has enormous impact on the formation of forest soils. With the advancement of science it became possible to apply biochemical methods which enabled scientists to examine not only the final product but to observe complete transformation processes. They not only studied the processes but also developed a classification of humus types.

Podsolization and hardpan

During the first decades of this century degradation of forest soils was observed in certain areas, mainly as a

Soil profile showing podsolization

result of conifer monocultures and clearcutting. It was characterized by podsolization and the occurrence of hardpan. In some areas, especially in northern Bohemia (Czechoslovakia), the growth of trees was declining and in some places had already stopped. It became almost impossible to establish new stands. A IUFRO working unit studied the phases of the degradation process and the causes, with the aim of developing rehabilitation measures.

Forest entomology

The 1929 Congress was the first to put forest entomology on the agenda. Despite pioneering experiments early in the life of many forest research stations, forest protection had been a forest research orphan.

Nun-moth survey, Lymantria monacha

Timber production and yield had been given priority. Now forest protection received more attention, and a special working unit was established in IUFRO which was active both during and between congresses.

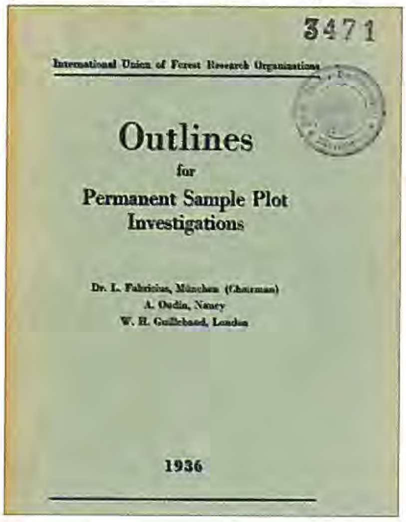
Wood testing

Investigations of the technical properties of woods continued to be the main topic of research. In this connection, close cooperation with the International Union for Material Testing, which had been founded in Zürich in 1927, and with its member institutes was sought, e.g., by employing engineers at forest institutions and, in exchange, foresters in technical laboratories. As in most research fields, IUFRO members wished to obtain international harmonization in wood testing as quickly as possible. Main factors to be examined were dry matter production, resistance to compression, bending resistance, elasticity, breaking strength, tensile strength, torsion strength, and hardness.

It was considered necessary to develop standardized working methods with regard to studies on the chemical composition of wood similar to those developed for studies of the mechanical resistance.

Harmonization of forest growth and yield investigations

It was in 1929 also that a committee for the harmonization of forest growth and yield investigations was created. Members were L. Fabricius (Germany), A. Oudin (France) and W.H. Guillebaud (Great Britain). At the 1936 Congress the committee presented a "Guide for forest growth



and yield investigations". It included establishment of experimental plots, first assessment, evaluation, intermediate assessment, final assessment, and wood properties. It was very detailed, but its structure allowed comparison of results even in those cases where it was not possible to assess every single value. The document was accepted by the Congress without modification and served as a basic tool worldwide up to the 1950s.

Bibliography and dictionary

The Swiss P. Flury, who as early as 1903 had had the idea of creating a forest bibliography and of standardizing forest terminology, was the impetus for the reestablishment of IUFRO's bibliographic working unit. The need was undeniable. As A. Oppermann, Honorary President of the 1929 Congress said, "forest chaos" prevailed.

Before the First World War a plan had been worked out to collect forest literature at a central location and to arrange it in accordance with a forest decimal classification system. Funds had been secured through subscription fees for index card copies. The war, however, spoiled the plan.

When the war was over economic crisis endangered the very existence of many forest experiment stations and the idea of a central forestry library had to be set aside. It was agreed, however, to collect, classify and translate new publications in the countries were they were issued and to make listings available on request to all member organizations. Twenty-six countries declared their willingness to cooperate. In 1935, guidelines for handling documentation and the Forest Decimal Classification in German were published. Translation into English and French followed. This laid the foundation for an international forestry bibliography known as the "Flury system".

Recovery After World War II

Although during the war forest experiments had not been totally discontinued and international contacts had not been completely cut, losses of people and material were so extensive that it was not possible to simply carry on from where activities had stopped before the war. The IUFRO Secretariat in Sweden did an admirable job of reestablishing international contacts. An example taken from the annual report of 1946 illustrates how difficult this task was under the confused political conditions in the destroyed and occupied European countries. One-and-a-half years after the end of the war the IUFRO Secretariat was able to communicate – with pleasure – to the members that "the Austrian experiment station at Mariabrunn is still existing".

National research centres – international transfer of knowledge

The new world order after the Second World War had an impact on IUFRO, too. In the USA the FAO (Food and Agriculture Organization) had been founded as a specialized agency of the United Nations. It first had its headquarters in Washington. Efforts were made to incorporate IUFRO into the FAO in order to formulate research aims more clearly, to avoid unnecessary duplication of research projects, and to reduce costs.

However, the IUFRO Secretariat objected strongly to such centralization and, at a conference held in 1947 under the chairmanship of E. Lönnroth, the plan was rejected. IUFRO's democratic and decentralized structure of international cooperation had proved to be efficient and flexible. There was no wish to be merged into a political body, and any conducting of research through a central agency was refused since the different institutions of the member countries worked independently. Scientific research was not to be bureaucratized. IUFRO itself was not designed to actually carry out research but to mediate, orient and partially coordinate forest research projects initiated by national forestry centres. Finally an agreement with the FAO was signed whereby IUFRO retained its independent status but had a specialized consultative status with the FAO. During the decade to follow the IUFRO Secretariat was even housed within the FAO which had meanwhile moved its headquarters from the USA to Europe. The American experiment stations, which had favoured merging with the FAO due to certain rules of the USA government, joined IUFRO again. Decentralization, independence, and international cooperation were thus confirmed as the basic structure and principles of the Union.

Emphasis on subject groups

The first congress after the war was held in Zürich in 1948. Its main purpose was to begin the reconstruction of the Union. The number of member institutions had decreased by one half, often due to lack of funds to pay the subscription fee. A new structure for the Union was decided upon with now 11 research sections which staff of member institutions could join freely. It was hoped that the research sections would deepen the relations between scientists and, indeed, they furthered international cooperation substantially.

The reorganization had moved international exchange of knowledge and experience from the level of the directors of research stations to the level of experienced scientific staff members. The activities of the subject groups became more dynamic, researchers were armed for problems to come, and it was reasonable to hope that they would be able to meet the challenge of a strong diversification of forest research which had to be expected.

Whereas before the First World War and between the wars strong efforts were made to harmonize and standardize forest research methods, emphasis after the Second World War was laid more and more on exchange of experience. The new disciplines had not yet secured enough knowledge to be able to develop standards and international cooperation met the interests of young scientists in particular.

The forest as an object of exploitation

Large forest areas had been destroyed by the war, and the need for timber for reconstruction and energy afterwards made the forest a mere object of exploitation. Large clearcuttings were made to supply timber for construction work and fuel production. Plantations of fast–growing tree species and suitability tests on construction timber pushed the traditional themes of forest research into the background for a while. Thus forest research had, beside new tasks, to treat the wounds which had been inflicted on the forest in times of distress.

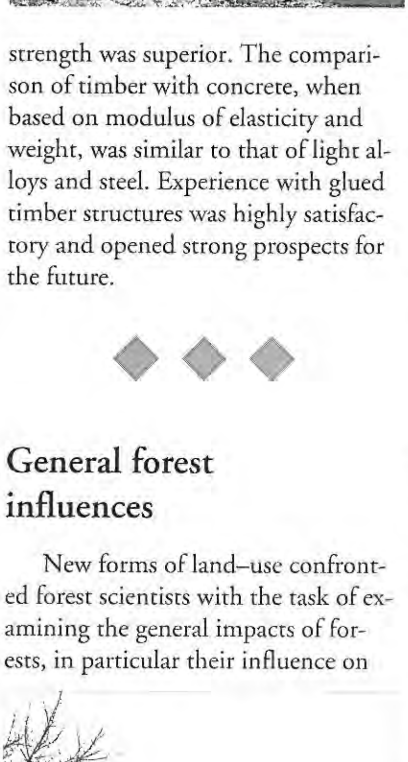
In many European countries overcuttings were recorded during the post–war period. Although in the years immediately after the war, while European industry was still in recovery, the forest was an object of exploitation, wood received increasing attention as a construction material. One of the major excursions at the IUFRO World Congress in 1948 was of a "technological nature", and one of the four main papers dealt with timber in construction. Timber was compared with concrete, the material of the future, and was generally found to be better suited for structural purposes. Its bending, tensile, and shear

strength was superior. The comparison of timber with concrete, when based on modulus of elasticity and weight, was similar to that of light alloys and steel. Experience with glued timber structures was highly satisfactory and opened strong prospects for the future.

◆ ◆ ◆

General forest influences

New forms of land–use confronted forest scientists with the task of examining the general impacts of forests, in particular their influence on



Shelterbelt trials

water regimes. The problem was considered to be very complex. Exact measurements of precipitation and studies on the structure and form of stands were promoted. IUFRO returned to the topics of its earlier times.

In many parts of the world worries about increasing water shortages were voiced. In some regions water supply was considered to be one of the most important functions of the forest. Afforestation programmes were given highest priority, and forest scientists were challenged to make afforestation possible by undertaking experiments on less suitable sites.

Another problem demanded forest scientist intervention. Mechanization in agriculture had led to the formation of vast areas which were exposed to the forces of nature without protection. Shelterbelts and scattered groups of trees would help combat threatened erosion. Forest scientists were thus called to cooperate with agricultural engineers.

Silviculture

The large research unit of the silviculturists worked, together with other themes, on methods of stand analysis. Proposals were put to the test in experiments. In order to be able to judge the effect of tending measures, quality characteristics were defined and efforts taken to standardize measurement and calculation methods.

Local difficulties occurred with the establishment and management of forest nurseries. Weed control, fertilizers, soil structure, water balance and transplanting methods were of general interest. Artificial establishment of pure and mixed stands, especially in dry areas, raised many questions. Large-scale afforestation raised a new problem - mechanization. As manpower and money were scarce, and for technical reasons, large–scale afforestation could be done by methods requiring limited labour input.

International provenance trials
(extract)

1906-1908
Pinus sylvestris; 8 provenances; Austria, Baltic Regions, Germany, France, Poland, Russia; (M. Kienitz, A. Schwappach)

1938-1939
Picea abies, Pinus sylvestris; 36 provenances; Belgium, Canada, Czechoslovakia, Denmark, Finland, France, Romania, Scotland, Sweden, USA; (H. Baldwin, W. Schmidt)

1944
Larix decidua, leptolepis, sibirica; 55 provenances, 23 experimental plots; Austria, Canada, Czechoslovakia, Denmark, Finland, France, Germany, Italy, Poland, Sweden, Switzerland, UK, USA; (W. Schmidt, S. Petrini)

1958-1959
Larix spp.; 68 provenances; Austria, Belgium, Czechoslovakia, Finland, France, Germany, Italy, Norway, Switzerland, Turkey, USA, Yugoslavia; (R. Schober)

1964-1968
Picea abies; 1100 provenances from 95 European regions, 20 experimental plots; Austria, Belgium, Canada, Czechoslovakia, Finland, France, Germany, Hungary, Ireland, Norway, Poland, Sweden, UK; (O. Langlet, K. Stern, W. Langner)

1970-1973
Pseudotsuga menziesii, Abies grandis, Picea sitchensis, Pinus contorta; 110 provenances; Canada, England, Germany, Lithuania, Scotland, USA; (H. Barner, H. Bryndum)

Forest plant science

In all countries there was a strong interest in the selection of stands and of individual trees for seed production. Priority was given to the selection of plus trees. The research group recommended the keeping of country registers which would be of permanent value for forestry around the world.

Seed exchange was continued, and international provenance trials established during war time were evaluated in accordance with standardized rules. Methods for mass production of seeds were developed, establishment of clonal archives was recommended, and a new international provenance trial with Douglas fir was given consideration.

Forest protection and entomology

As a consequence of vast clearcuttings and drought periods, serious epidemics of harmful insects had occurred. Forest protection was challenged to find remedies in a short time. It was hoped to get mass outbreaks of insects under control by use of insecticides and almost everybody was optimistic about the applicability and efficacy of chemicals. DDT was the magic word. Airplane dusting was still used only sparingly but was considered an appropriate cost- and laboursaving remedy.

The insecticides were effective, however, against a broad range of insects. They were not at all species-specific and non–target species were reduced in the long run also. It became necessary to face the development of resistance and, in particular, the reduction of parasites. There was a great risk that insecticide control measures would cause further mass outbreaks of harmful insects. Entomologists were confronted with the need to study development processes of insect populations and to control them in order to prevent future outbreaks.

For the first time also biological and biotechnical methods for pest control, such as natural pheromones, were taken into consideration.

Bark beetle

Another field of research was whether and how pests could be controlled by silvicultural measures. When monocultures were established for the first time, e.g., poplar plantations, clones were no longer selected just for yield but also for resistance to pests and diseases. Close cooperation between entomologists, pathologists and breeders was sought. Forest pathology made much progress, mainly in the USA. Breeding of pest- and disease-resistant trees was started and IUFRO was able to play an important role in the transfer of knowledge and experience to Europe and Japan.

Forestry economics

For a long time large–scale forest enterprises were considered to be the ideal for a forester, and the trend of the time was to move in this direction because of, among other things, nationalization. However, the research unit of IUFRO concerned with these matters emphasized the value of small-scale forestry and the necessity of protecting small forests. It recommended also the helping of small forest owners through governmental grants and technical advice.

Internationally, the need to apply modern management sciences to forestry also became obvious. Forest cost accounting was in its beginnings, problems of interest calculation and assessment of labour productivity had to be solved. Scientists made efforts to develop generally applicable methods which could be adapted to the specific needs of different countries and enterprises. Terminology uncertainties had to be overcome, so close cooperation was sought with the research unit for bibliography and terminology.

Growth and yield science

The World Forestry Congress of 1949 considered it an urgent need that foresters be able to assess increment as quickly as possible under different conditions. Accordingly, that Congress approached IUFRO. A very useful exchange of experience between the member organizations followed so that it became possible to compare different methods, from permanent sample plots to national forest inventories.

In this discipline, there was a strong trend to unify research methods, but it was decided to proceed cautiously. Yield tables would be established by each country according to its own methods but, wherever possible, changes of site conditions and tending practices would be taken into consideration. Also, methods of determining allowable cut could not be standardized because of the different forest and economic conditions. Accordingly, scientists limited themselves to exchanges of experience.

Regression analysis was introduced to enhance classical graphical methods. Quantitative growth studies were combined with qualitative studies. As growth variations were not only caused by weather extremes but also by the occurrence of seed years, it was recommended that this be taken into consideration during evaluations.

Operational efficiency

For practical reasons research had focused mainly on logging. Construction of forest roads, the development of new felling and extraction techniques, in short, mechanization and rationalization of wood production, were the main interests. But in 1953, at the Rome World Congress, a new section, dealing with the impact of such development on man, was created. The section members wanted to study the impact of new working conditions on the health of forest workers because their well–being was "of equal or even greater importance than the tending of the forest and its products". It was pointed out that such studies would be essential also for tropical countries because in every part of the world forest worker environment deserved the "full attention of a socially responsible forest officer".

Collaboration of physicians and social scientists was sought. Cooperation with the World Health Organization (WHO) and the International Labour Organization (ILO) would be established. Beside this, an effort was made to make comparable work studies which had been carried out in different parts of the world. Work-physiology studies linked with time studies led to the development of standard value tables. This was considered to be socio–scientific pioneering research that is still applied in some countries today.

Respiration measurements on a forest worker

Properties of forest products

The old research themes of "wood technology" were gradually taken over by the wood–processing industry and by specialized institutions. The IUFRO research unit concerned concentrated on studies of the interrelations between forest growth, the biological formation of wood and its physico–mechanical properties.

Such studies were made in close cooperation with ecologists, geneticists, and physiologists. Special attention was paid to the influence of geographic site and to moisture in the tree and the humidity of its environment. New sampling methods were developed and adjusted to both range and timber species. Wood was examined with regard to the demands of the market and reasons for growth abnormalities were studied. Efforts were made to define the main properties of wood and to develop the basis for a technological wood classification.

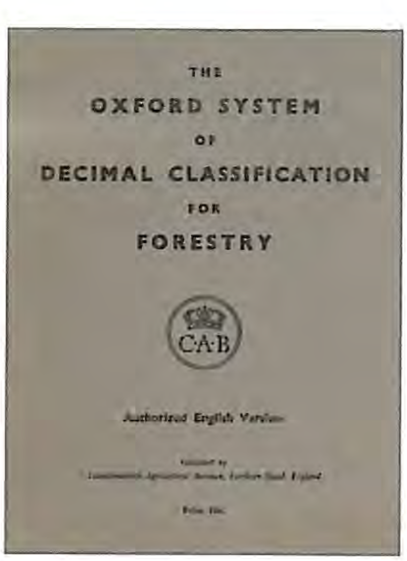
Closed bordered pit in Pinus sylvestris, 1:8500, 1952

Forest Decimal Classification

Experience with the Flury international bibliography system developed in the 1930s, as reported earlier, had been positive. In 1948, at the first session of the "Bibliographic Committee", the Commonwealth Forestry Bureau in Oxford, under the chairmanship of F.C. Robertson, presented a completely revised version which had been developed in coordination with the Forestry Commission (Alice Holt) and the Forest Products Research Laboratory (Princes Risborough). The main work was done by G.P. Beak.

It was an excellent basis. IUFRO approached the FAO to set up a joint bibliography committee. FAO agreed and nominated J.D.B. Harrison and R.G. Fontaine, IUFRO Secretary at FAO Headquarters, the latter being a vigorous promoter of the project. The committee called in other specialists, made a thorough study of the document and revised it cautiously. In subsequent years the International Association for Documentation in The Hague was contacted several times. Finally, outstanding forest scientists, such as K. Mantel and K. Abetz from Germany, were consulted, and several sections were completely revised.

At the IUFRO World Congress in Rome in 1953 the document was presented to the participants in English by the chairman of the committee, E. Saari. The Congress recommended its use to all IUFRO member organizations. Two months later FAO agreed to use this system. A seminal standard, the Oxford Decimal Classification (ODC) for forestry had been born. Translation into French, German and Spanish followed. The ODC



was destined to become an indispensable aid for forest scientists around the world.

Closely connected with the publication of the ODC was, after a few years of cooperation between the UNESCO (United Nations Educational, Scientific and Cultural Organization) and the FAO (Food and Agricultural Organization), a publication of forest terminology.

The "Oxford System" had fulfilled a task that went beyond its technical scope. Its compilation had brought together a great number of forest scientists who were thus able to profit from the scientific and personal contacts for their own research. The ODC marked the beginning in IUFRO of a new form of scientific cooperation.

Research Units 1962

0. General

Section 01 Bibliography and Terminology

Subjects of research: Classification of forestry literature. Technique and organisation of documentation. Terminology.

Section 02 History of Forestry

Subjects of research: Methods and terminology of the history of forests and forestry. Comprehensive collecting of the literature on forestry history. Completing the national bibliographies about forestry. Studies on the effects the activity of important persons in forestry and forestry practice has had on the development of forest economy. Evaluation of the results of research in the history of forests and forestry (history of forest management, stand and stocks) and its practical effects.

1. General Forest Influences

Section 11 Forest Influences and Watershed Management

Subjects of research: Effects of forests on local climate, disposition of precipitation, and erosion; and methods of improving water yields and controlling torrents and avalanches.

2. Forest Production, Establishment and Maintenance of Forests

Section 21 Research on Site Factors

Subjects of research: Study on climate, soil and vegetation of forest sites. Site evaluation and site productivity. Relations between forest stands and site factors.

Section 22 Study on Forest Plants

Subjects of research: Exchange of information about the characteristics and development of forest plants in the temperate, sub–tropical and tropical regions of the world, with particular reference to tree physiology, tree genetics and breeding, and the anatomy, morphology and taxonomy of the tree species important to forestry.

Section 23 Means for Amelioration of Forest Production (Silviculture)

Subjects of research: Study of the structure and dynamics of stands (stand analysis). Methods and applications of silvicultural systems. All aspects of formation, tending, and regeneration of stands. Techniques of afforestation. Forest nurseries.

Section 24 Forest Protection

Subjects of research: Damage to the forest by virus, fungi and other plants, insects and other animals, man and inorganic agents. Prevention, and control measures.

Section 25 Study of Growth and Yield and of Forest Management

Subjects of research: Quantitative and qualitative study of growing stock. Determination of increment and of annual cut.

3. Forest Economics – Operational Efficiency

Section 31 Forest Economics

Subjects of research: Computation, book–keeping, assessment of financial returns, statistical records. Economic management. Forest valuation. Social economics of forestry.

Section 32 Operational Efficiency

Subjects of research: Efficiency studies in all branches of forestry. Improvements in equipment, methods of working and organization for the extraction, grading and transport of forest products.

4. Forest Products

Section 41 Forest Products

Subjects of research: Timber quality, mechanical transformation and protection, use of wood for construction and packages, fiber and chemical wood products.

Annual report 1962, p. 22-24

Economic Growth

The period described in this chapter (late '40s to mid-'70s) was characterized by worldwide change, the emergence of the developing countries on the political stage, and continuous economic growth. Wood as a raw and working material was superseded by other materials. "Plastics" was the keyword of the time. In many European countries profits from forestry were decreasing and interest in the forest as an economic object was receding. Under such circumstances mechanization and rationalization of forest operations were of essential importance. On the other hand, there was growing interest in the benefits of the forest for people in an industrialized world (landscape, climate, hydrology).

North America, the Soviet Union and a number of other countries started to practice forestry on a large scale. Their products entered the world market and competed with Central European products. Industrial methods became aims of orientation. New management and harvesting methods were created that were completely different from traditional methods which had been developed in the comparably smaller areas of Central Europe. In the developing countries, opening of the tropical forests started.

Changes were also occurring in forest science. Empirical descriptions of visible interrelations, such as measurements of trees and growth, problems of seed provenance, fertilization, or root growth changed to analytical methods, to the explanation of causal connections. Many of these connections could be studied only by methods that came from outside forestry and were then adapted, such as statistics, biometrics, biochemistry, physiology and genetics. A wide spectrum of forest sciences came into being which would not have been imaginable a few decades before.

Different trends in forest science began to take shape. The "conservative" methods of cautious experimentation were pushed to the background. "Trendy" were those methods which brought quick results, though often with only one dimension. Sceptics of mere quantitative growth were mostly not listened to. During the period the centre of gravity of forestry was displaced from Europe to North America where the younger disciplines were booming.

In these years IUFRO recorded rapid growth. The number of member organizations increased by more than double. A pleasant fact was that newly founded forest research stations and institutions in the developing world joined IUFRO and were represented at congresses and in research units by outstanding scientists. This multiplication of tasks and of members brought about the need for a substantial reorganization of IUFRO. A new structure created in 1971 remains the basis of IUFRO's structure today.

In summary, before the First World War, IUFRO's organs were only the President and the assembly of members. Between the world wars the top level was enlarged by the addition of the International Committee and of a board, the Permanent Committee. The President was given a Secretary–General. The scientific work was done in five or six sub–committees, which were very efficient.

In 1948 the sub–committees were replaced by 11 research sections whose range of tasks grew in the course of time (as an example see the scheme from 1962 on page 15).

At the Munich World Congress in 1967, which attracted around 1,000 delegates and the proceedings of which had more than 7,000 pages, it became evident that reorganization was again needed. In 1971 it was decided to structure the Union into divisions, subject groups and project groups, thus creating some 200 units. The Permanent Committee was replaced by an Executive Board, which included the President, the Vice–President, six Divisional Coordinators and nine Members from IUFRO Regions. The daily work had grown to a volume which could no longer be handled by the President alone on an occasional basis. Therefore, in 1973, a permanent secretariat was installed at the Federal Forest Research Institute in Vienna, Austria. Bookkeeping and financial administration were assigned to the Federal Forest Research Station of Switzerland.

The work of the research units became so diversified that only short introductions to some actual themes are given below as illustrations without any attempt to assign relative values and without presentation of results.

Opening of virgin forests

IUFRO faced the following situation. The increasing demand for wood, mainly for chipboard and for pulp and paper production, led to the harvesting of large, untouched areas. In the northern hemisphere, in the temperate and boreal forests of Canada and Russia, and in the southern hemisphere in the tropical forests, lay a challenge taken up through the development of new harvesting methods and the establishment of a timber-using industry. The palisander desk

became a status symbol, the living room in mahogany showed that one "had made it".

Timber harvesting

Convinced by the spirit of the time, the belief in unlimited growth, it was thought that, in forestry, the general trend would lead to "overall industrialization of the work of forest enterprises" (1967 World Congress). The "technical" orientation in forestry gained considerable influence, the use of mechanized harvest machine sets was considered "nothing less than a revolution". The supporters of the technical orientation saw the future in technology. They wanted forestry to catch up with agriculture which had gone this way more than a century before. Forestry was confronted with the task of studying the impact of mechanized methods on forest stands, and to experiment with the establishment of machine–suited stands.

Problems were expected in steep mountain forests but the technical possibilities seemed to be unlimited. First experiences with overhead conveyors, cable cranes, and balloon and helicopter transportation seemed to point to the solutions of the future. Only with regard to thinning was there no sign of a breakthrough and so effort focused, for example, on genetic research, with a view to creating forests that needed less thinning.

Simultaneously, ergonomic studies in cooperation with the ILO were continued, and the impact of the new technology on the health of forest workers was investigated. Studies were conducted on work conditions, subjective work experience and psychosomatic health; monotony and mental overload; forestry machine vibration; noise stress in wood harvesting; development of ergonomic checklists and methods of time measurements; and prevention of accidents.

Afforestation and genetics

Large–scale clearcutting was considered to be the most rational harvesting method at that time. Reforestation was planned to be done by machine and, possibly, with improved genetic material. Seed plantations were established on a large scale, mainly with fast–growing and highly productive tree species. What the radiata pine was for southern hemisphere countries, the Douglas fir was for Central Europe. The "green revolution" of agriculture had become a model for parts of forest science.

In this context research in forest genetics received strong impetus. International provenance trials gained in importance. Breeding of trees which were resistant to pests and diseases, as well as air pollution, was pursued. In the period from 1964 to 1968 IUFRO established an international

Provenance trial, Colombia

provenance trial with Picea abies. The experiment included 20 experimental sites in 13 countries and compared 1,100 provenances.

Site research

Special credit has to be given to IUFRO for having had, in a time of target–related thinking, a large research unit which worked on the complex site theme. The manifold landscape–related and environmental factors which have an impact on the development and growth of the forest were studied: soil characteristics, light conditions, weather influences, forest recreation, game management, and air pollution. The effects of irrigation and aeration of forest soils were studied, an international comparison of methods of chemical analyses was developed and the project "Forest ecosystems of the world" was initiated. It was aimed at a compilation and summary of classifications and small–scale maps to facilitate inter-and intracontinental transfer of ecological knowledge.

Since the 1960s scientists had been working on the standardization of site–related terminology. Moreover, the project "Inventory of methods of site classification and mapping" was implemented. Further investigations were made on site alteration, especially soil changes due to the planting of non–indigenous species, and quantitative studies of site factors. Effects of fertilization on site were studied with special diligence and the working unit coordinated IUFRO activities dealing with this subject.

Fertilization

Quantitative growth was asked for, so various fertilization trials were carried out in forest stands from the

Dusting with lime

ground as well as from the air. In Northern Europe a forest area of 10 million ha was estimated to be "fit" for fertilization. An increase in annual allowable cut of 30 million m^3 was expected. Sometimes, however, damage was greater than benefit when commercial formulations were applied without sufficient investigation of specific site conditions. With the passing of time, concrete recommendations were developed for the fertilization of individual stands as well as rules for fertilization in general.

Pesticides

This period was also the great time for pesticides. Chemicals were believed to be the best remedy against pests and diseases. Insecticide application to stop Dutch Elm Disease is an example. IUFRO, however, did not establish a research group on pesticides during the time of DDT. The Union intensified its cooperation with the FAO in order to strengthen research in the fields of entomology and pathology. Emphasis was laid on the inter–disciplinary nature of the cooperation. It was introduced by two large international symposia on forest pests and diseases in Oxford, 1964 and New Delhi, 1974.

Aerial imagery and remote sensing

In the 1950s, aerial black-and-white photography was used for forest mapping, forest inventories, and forest management. The development of colour and false–colour photography (see page 24) and of infrared imagery offered new possibilities for remote sensing in the newly established forestry disciplines of forest protection, forest engineering, environment protection, forest inventory, and forest mapping. The possibilities for remote sensing were accepted only hesitatingly, however.

Reforestation in the surroundings of a copper mine, Japan

Damage by air pollution

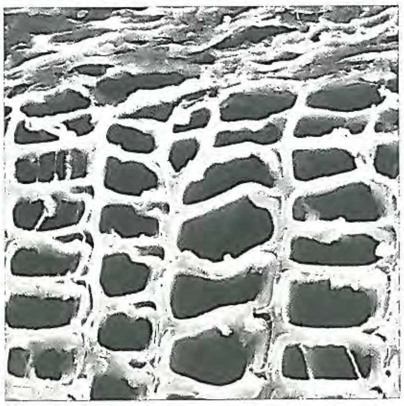
Air pollution research dealt mainly with measurements of the damage to forests near emission sources in industrial and mining areas. At first, the effects were of local concern only, but since the 1960s the long-range effects of pollutants have also been investigated. In certain countries some forest areas destroyed by mining were reforested. In some of these areas there are green forests again, such as in the surroundings of the terrain shown in the above picture.

Wood research

Wood research received fresh impetus in many countries largely because of the worldwide boom of the wood industry. An example of close cooperation between research institutions and industry was the development of particle board. In a short time its production reached huge volumes due to the improvement of production techniques and machines.

Different challenges presented themselves to wood researchers in connection with other products and product improvement, e.g., in the fields of wood drying and wood protection. In addition, knowledge about under-utilized tree species was continuously expanded through investigations of wood quality.

International cooperation between forest researchers became more and more important and was substantially furthered through the connections within IUFRO.



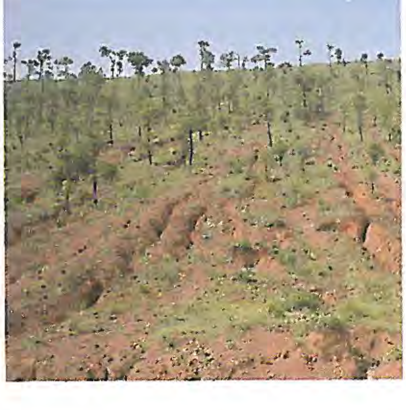
Electronic scan microscopy of Pinus sylvestris

Beneficial effects

A counter-movement developed during the quantitative growth phase. The forest should not be reduced to just a source of raw material. Its complex functions affecting man, landscape and environment should also be taken into account. Within IUFRO, G.M. Jemison, USA, IUFRO President 1968–1971, was an able promoter of these ideas. During the 1971 World Congress in Gainesville, USA, the Chief of the Forest Service of the host country was able to report that, in all questions of forestry in the USA, not only forest management but also protection of the environment and the improvement of the recreational function of the forest, would be taken into consideration. The ideas were soon well received worldwide and in the 1960s the first studies on the forest as a complex ecosystem were undertaken.

Torrent and erosion research

In the industrialized countries the penetration of human settlement into uninhabited mountainous territories presented new problems to torrent and avalanche researchers. Beside technical control measures, researchers in IUFRO discussed the impacts of afforestation at high altitudes and of silvicultural measures in torrent catchment areas. In the developing countries erosion became a widespread problem.



Environment and Resources

The shock of the oil crunch at the beginning of the 1970s did not result in a reorientation but in the continued pursuit of the idea of growth through alternative energy sources. For some forest scientists the term "energy forest" seemed to indicate the future task and orientation of forestry. Considerable research was conducted through short–rotation trials for the production of forest biomass. Woody raw material was to be produced like petrol and, moreover, it was renewable.

But gradually the idea that a forest is not just a field stocked with trees but a complex ecosystem that needs to be protected and maintained for future generations was rekindled. The idea of sustainability, an old forest principle formulated almost 300 years ago when forestry was in a difficult situation, was gaining ground. Through growing awareness of the limits of natural resources and endangerment of the environment it started to become a generally accepted principle of forestry all over the world. The IUFRO division "Forest Environment and Silviculture" advocated at the 1981 World Congress that "this principle should be extended to all fields of human activity, especially to those involved in the production of renewable resources".

The idea of sustainability was also taken up by other research branches and became their guiding principle. Originally just a guideline for the treatment of forests, long–term maintenance of their productivity, and satisfaction of the material and aesthetic needs of mankind, sustainability has increasingly become a guideline for the preservation of our natural heritage and a rule of action for the treatment of ecosystems.

Global problems and forestry

Social, economic, and ecological problems of global importance have characterized the last quarter of this century. They cannot be solved by isolated measures and forest scientists are thus facing new challenges. The former aim of forestry to ensure wood supply has been superseded by the necessity to conserve forests, to contribute to the survival of mankind, and to prevent ecological catastrophes.

Extract from the Ljubljana Congress Declaration: 1986

◆

"Dramatic losses of forests, with consequent losses of soil and decline of soil productivity, are occurring in tropical countries because of expansion of agriculture, urbanization, overexploitation of forest resources themselves, and increasing demands for fuelwood and other products. Rapidly increasing sizes of human populations, changing conditions in land tenure, and lack of social stability are serious political and cultural issues impeding solutions.

Equally threatening is the increasing damage to temperate forests caused by the polluting effects of various industries, traffic and heating of houses on the air, water, soil and trees themselves. Although scientists have sufficient information to suggest provisional remedies, exact cause and effect relationships are not sufficiently known. The great impact of forest fires should also be considered."

However, these problems can no longer be solved by foresters alone, nor by sectoral strategies. Solutions depend to an increasing extent on decisions made outside the forestry sector. Extensive reclamation of land, and air pollution, are just two examples. Forest scientists can no longer concentrate solely on their scientific work but are more and more required to define themselves and their activities in a socio–political context.

The scenario is less optimistic than in the 1960s. It even becomes apocalyptic. The following are some of the well–known topics in keyword terms: large–scale deforestation for the purpose of food production, dramatic destruction of tropical forests and unrecoverable ecosystems; air pollution, soil acidification, ozone problems, greenhouse effect, forest decline in industrialized countries; lack of drinking and industrial water, transformation of forest into steppe, desertification, climatic disasters, floods, erosion.

The global, mainly political and economic, problems of forest and environment conservation make a reorientation of forest research necessary. Research activities, which so far have focused on almost nothing else but natural science and technology, must include socio–economic aspects, as IUFRO divisions have been demanding for years. In addition, social and environmental aspects have also to be taken into consideration.

Conservation of the forest is becoming part of a global environmental protection policy. The diversity of forest ecosystems has to be conserved in order to ensure biodiversity in general, to protect nature and landscape.

IUFRO has already responded to this need by restructuring one of its divisions under the name "Social, economic, information, and policy sciences". Thus socio–economic research has been integrated into the activities of the Union, giving impetus to national research institutions.

Deforestation in the tropics

The dramatic decline of tropical forests was discussed at the Kyoto World Congress in 1981. As a result of these discussions the Special Programme for Developing Countries (SPDC) was founded (see page 27). The Congress declaration described the situation as follows: "Unless appropriate measures are taken, increased exploitation will in many regions endanger not only the future supply of goods and services from the forest but also the forest gene resources, agricultural production, water resources and the human environment."

Impoverishment of rural populations, extreme population pressures, abandoning of traditional management methods and unadapted land–use in developing countries, and the interest of industrialized countries in low–cost tropical timber are facts which have existed since without reduction and with which we shall have to cope yet in the future.

The following paragraphs present just a few examples out of a large number of topics of interest to IUFRO. A list of all themes dealt with by IUFRO may be found at the end of this booklet. An outline of the activities of the research unit concerned with forest decline and air pollution is given as an example.

Energy crisis and plantation forestry

In the 1970s concern about possible dwindling of oil supplies made renewable resources and thus short-rotation forestry an actual theme in industrialized countries. The discussions reached circles even outside forestry and for a short time it was "trendy" to talk about plantation forestry or utilization of wood waste. In the developing countries the theme was and still is of intense interest.

Fuelwood is the main energy supply for two billion people. If forests disappear a shortage of wood can be worse than a shortage of food. The IUFRO World Congress in Kyoto recognized "a worldwide need for the investigation in fuelwood supply in deforested regions and for the utilization of forest biomass for energy production".

Meanwhile much research work has been carried out in fuel wood plantations and strips of forest have been established in the surroundings of villages. Specialized IUFRO working parties are dealing with plantation forestry in Africa, Asia, and Latin America. Plantations of fast–growing tree species are considered reasonable solutions in countries where there is abundant uncultivated land and wood production does not compete with food production.

Development of plant material suited to site, establishment of different plantation types and cultivation of a great variety of tree species are primary problems. It will be essential to develop preventive measures against outbreaks of pests and diseases to which such plantations might be susceptible.

Conservation of natural tropical forests

Quite late, but massively during recent years, public pressure to protect virgin forests in the tropics has increased in order to conserve for future generations at least part of those regions of highest biodiversity, that is, those with the greatest number of different plant and animal species per unit area. The loss of these forests implies more than just the loss of forested area, and so foresters are strongly supported by the public in their fight for the conservation of such areas. Biologists estimate that the South American rain forests are inhabited by 10,000 to 15,000 undescribed plant species and the rivers by 2,000 unknown water organisms. Forty per cent of our current medical drugs are made from plants, microbes, or animals, or from natural derivatives, so that physicians, pharmacologists and biochemists find an immeasurable treasure in these forests.

Several countries have put large areas under protection or established national parks. But these measures are still insufficient. Forest scientists are challenged to the extreme because knowledge about the ecology of tropical forests is only at its beginnings and more knowledge is an essential prerequisite for the taking of further measures.

Declaration of the Division "Forest Environment and Silviculture" (Montreal, 1990)

◆

"The steady decrease of forest area, especially in the tropics, changes in macroclimate, increased airborne pollution, as well as the inappropriate use of forest affect worldwide the stability of natural and artificial forest ecosystems and future potential forest benefits. Through the development of proper silvicultural techniques, based on scientific knowledge of the functioning of forest ecosystems, biological diversity should be maintained, negative environmental effects minimized, sustainable forest utilization assured and forest heritage preserved for the future. In order to improve productivity and ensure healthy forest ecosystems, new silvicultural methods should take into account innovative research in the areas of biotechnology, biological nitrogen fixation amongst other, and use recent developments in multi-resource decision models for management."

The following themes, among others, are being discussed in IUFRO research units: reduction of the pressure on natural forests and on degraded sites with, where possible, valuable indigenous species in mixed plantations; fixed annual allowable cut, equivalent to annual increment, based on inventories of the natural forests; sustainable and nature-conforming management methods based on long-term planning; application of careful felling and extraction techniques to foster natural regeneration; rational processing of wood waste in the forest in order to maximize raw material gain thus reducing pressure on other forested areas; sustainable management of secondary forests in areas of degraded primary forests and on abandoned pastures.

Thinning

What used to be a problem for the preceding generation has now been solved to a large extent by technical measures: mechanized thinning in suitable areas and stands, especially in plantations. Still unsolved, however, are forest-related and economic problems, which were described by the IUFRO group concerned as set out below.

Damage to trees and soil are obvious. Therefore, it will be necessary to pay special attention to the development of machines which are least harmful to the forest. Assessment of economic efficiency must consider not only thinning costs but also silvicultural aspects. Mechanical thinning makes great demands on both machines and operating personnel. Ergonomic studies should be carried out and, in the course of the day, the operators should work with different machines, in order to reduce the physical load.

Attention was paid also to traditional thinning methods. In particular the silvicultural, technical, and economic aspects were analyzed. Conversion from natural to artificial forests, which has been practiced for decades, and a high degree of mechanization require close cooperation between stand establishment and forest management. In the 1980s a global study was carried out on questions of stem density and selection with regard to stand development, forest work, and profitability.

Genetics

Forest genetics research has been an important part of IUFRO cooperation since the very beginning of the organization. In recent years, new problems and programmes have supplemented long–term research on provenance selection, breeding, and the development of seed orchards. The changes have resulted from the application of new plant science technologies that have put more research into the laboratory. New IUFRO groups have been formed and older ones have changed direction; a few examples follow.

Some IUFRO working parties are now concerned with advanced–generation breeding which requires new applications of breeding theory and quantitative genetics to long- and short-term strategies. In fact, the ties between field and laboratory in quantitative studies are close. In the laboratory, analysis of isoenzyme variation has become a routine procedure for studies of gene frequencies in both natural and artificial stands of forest trees, and for studies of the evolution of species and populations. A more recent application is the study of tree mating in complex tropical ecosystems. The newer, relatively simple procedure that detects genetic variations in DNA fragment length by cutting it with restriction enzymes is a very sensitive tool for more precise analysis of genetic differences between individuals and populations. The technique is also being applied to the mapping of tree DNA sequences that, as markers, will later help to locate useful genes in the genome and on the chromosome.

Rapid progress in plant molecular biology research provides new impetus for the development of growing plants from cells for mass–production of "transgenic" trees. Research workers are using molecular methods to identify, study, move and modify genes by molecular methods, including genes affecting insect and diseases

resistance, wood properties, drought resistance, and nitrogen fixation.

With the advent of concern about entire forest ecosystems, geneticists must balance the need for extensive forest planting with the importance of natural biodiversity conservation. Genetic improvement may produce plantations of a single species with genomes that, although superior in certain product–related traits, may lack unknown adaptability genes found in trees selected in the natural forest by long–term evolution. Thus we face an urgent need for more IUFRO cooperation in research on the gene pools of natural tree populations, some of which are being reduced in diversity by air pollution. To ameliorate the global warming trend, large–scale tree planting with improved, fast–growing types can significantly reduce carbon dioxide emission into the atmosphere, but we will also need to direct long-term breeding programmes toward adaption to the climates of the future.

Forest protection

The sometimes excessive application of insecticides in agriculture, horticulture and on cotton- and wine-plantations has had effects also on the various types of control of pests and diseases in forestry. Methods for prediction and prevention of mass outbreaks of noxious insects, such as forest hygienics which required much time and staff, had been in use since the turn of the century. Such survey and prevention methods were superseded by less expensive methods of pest control. The application of pesticides allowed control even in a more advanced stage of insect damage. Forestry was looking for low–cost remedies against pests and diseases, which problems were sometimes caused by improper silvicultural methods or inappropriate forest management targets in the past or at present.

IUFRO's research groups looked for alternatives to chemical plant protection and made efforts to make those applicable. Integrated bark beetle control, i.e., application of different control methods in a sequence, and the results obtained by studies of population dynamics of *lepidopterons* should be pointed out. The development and improvement of bark beetle attractants and of pheromones moved away from chemical strategies in the direction of pest monitoring and biological and bio–technological control methods.

Likewise the research groups concerned with pathology emphasized biological control of diseases. Cooperation with the European Plant

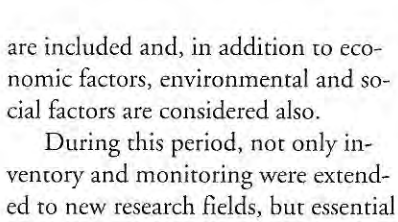
Protection Organization (EPPO; Prof. Mathys) resulted in the publication of a compilation of noxious organisms listed by danger potential. This led to the development of guidelines and limitation of pesticide application. In the classical field of entomology we can find, during the period concerned, studies on root and butt rot, poplar diseases, elm disease, cone and seed insects, injurious insects in afforestations, and more.

IUFRO research groups also started to work on forest insects and forest diseases in the tropics. In India investigation of mycoplasma diseases was initiated. It meant that, for the first time, the gap between classical noxious organisms and fungus diseases could be described. This research discipline spread quickly in Southeast Asia. A central theme for entomologists became the integrated control of the mahogany borer, *Hypsipyla*, because the application of insecticides had so far been without success. The creation of the working party "Pests and diseases of pines in the tropics" and later "Protection of forest in the tropics" allied IUFRO with the protection of afforestations in developing countries.

Forest inventory and monitoring

The growing public awareness of the threat to forest ecosystems led, mainly in the 1980s, to an extension of programmes dealing with forest inventory, resource monitoring and resource management. In the 1970s, inventories were still restricted to the assessment of forest area and timber volume. Nowadays all forest resources are included and, in addition to economic factors, environmental and social factors are considered also.

During this period, not only inventory and monitoring were extended to new research fields, but essential changes in research instrumentation and methodology also occurred. To give just some keywords: collection of resource data in the tropics and boreal



regions, multipurpose inventories, multi–step and multi–phase sampling, remote sensing and forest inventory, geographic and forest–related information systems, mathematical models for forest inventory. New technologies for data capture and evaluation, satellite–based remote sensing for mapping and stratification, global positioning systems for navigation to field locations, use of data recorders and laser measuring devices to capture data, data exchange between different types of computers from laptops to mainframes.

Urgently needed are a standardized terminology, definitions, classifications, and standards for the assessment of forest resources and for environment protection, as well as the development of a standard methodology in the fields of assessment and monitoring. In addition, integration and coordination of national and international inventory and monitoring systems are needed, as well as of data bases, in order to be able to better determine environmental data in the future.

Especially fruitful was the cooperation of the IUFRO research unit with other associations concerned with natural resources. Themes dealt with included ecology, pastures, game, and management methods in watersheds.

Forest operations

A dramatic change of forest work through mechanization took place in the industrialized countries in the period 1955–1980. It was caused by interacting factors such as fast–rising wages, cheap energy and technical advances in many fields, for example in metallurgy concerning light metals, in hydraulics, and in electronics.

During the 1950s and 1960s the chain saw and the skidder were introduced and changed forest work habits world wide. In the 1960s and 1970s mechanization of the felling, delimbing and bucking operations was introduced on a large scale. The development of the grapple loader improved truck transport immensely and made the development of forwarders possible. Truck and rail transport replaced floating and river drives. Mechanized methods in plant production and reforestation were developed.

In the mid-1970s increased attention was given to utilization of the forests for purposes other than timber and pulpwood. Biomass for energy became an important topic in the industrialized world, as did utilization of tree foliage to some extent.

At all times scientific studies of forest operations and techniques have been focussed on the interactions of worker and machine with the forest. However, in the beginning of the period, the focus was on the machines and mechanization per se while later on the adaptation of technology to issues other than short-term production economics gained increasing attention. This has been reflected in the development of the structure of the Division "Forest operations and techniques", for example, by adding working groups dealing with small-scale forestry (in 1986) and addressing environmental problems (in 1990). In the field of ergonomics there has been a shift in focus from work physiology to occupational

health and psycho-social issues.

The work of the Division has in the past been dominated by Northern and Central Europe and North America. There is a serious lack of participation by institutions and scientists from the developing countries. This situation is reflected in Division 3 membership: at present 54 of the 70 office holders come from Europe and North America, another 5 from the Western Pacific and only 9 from Africa, Asia and Middle and South America together. The challenge of the future is participation in the work to develop institutions and expertise in these other parts of the world.

Forest products

Variations in the structure and properties of wood led to both benefits and problems in its use. Studies of the relation of wood properties and growth conditions to use characteristics have made possible improved use of a wide variety of under-utilized species in the natural forest by taking advantage of desirable characteristics and by avoiding undesirable ones.

As wood has become more familiar and more generally used as a material of construction, effective means of both structural grading and structural use have become increasingly important. Study and discussion of this have made possible international standardization of nondestructive testing and grading of structural softwoods in world trade. In a specific application, timber bridge research has demonstrated the feasibility of using under-utilized woods for this type of structure.

Drying of wood is a critical step in preparing it for most uses. It is also a step in which energy consumption is high and possibility of defect development is great. Research and effective interchange of information have greatly improved the capability to dry wood economically and efficiently for many of its most important uses.

By the same token, wood in structural or domestic uses can burn if it is not properly used or protected. Extensive study of the fire performance of wood and of fire retardant treatments has led to broadly available information on ways of avoiding such problems. Wood–based composites have provided a way to use a wide variety of the timber resource to make essential products. The use of wood in veneer form received much research attention in the early 1970s. Results are being applied still in many countries. More recent research has made

possible the use of small flakes or strands of wood in structural panel products. Research on a powered backup roll for peeling veneer and steam–injection pressing have broadened possibilities for use of wood species and wood adhesives. Technology and standards for effective manufacture and use of composites have resulted from IUFRO's broadly based studies and discussions.

Among the more recent activities of researchers in the division have been the study of optimization of lumber manufacture to improve both volume and value recovery from the resource and the application of knowledge–base expert systems in making decisions for computerized control of the manufacturing process.

Contributing especially to the advancement of wood research in the developing world have been workshops in South America, Africa, and Southeast Asia designed to identify research needs; determine requirements of people, facilities, and funds; and establish networks of researchers with similar interests.

RESEARCH UNIT AIR POLLUTION

SO_2 and HF concentration limits
Resolution of Ljubljana, 1978

◆

$\mu g/m^3$	AM[1]	DM[2]	97,5 perc. HM[3]
SO2	50 25*	100 50*	150 75*
HF	0,3		0,9

[1] Annual mean, [2] 24 h-mean, [3] ½h-mean

* maintenance of full production and environmental protection.

Forest air pollution experts from countries with so–called "classical" damage – Poland, Czechoslovakia, Germany, Austria – have met regularly since 1957. This group was included in the IUFRO section "Forest plants and forest protection" at the IUFRO World Congress in Munich, 1967. Thus cooperation in this forest research field of increasing importance, which went beyond the borders of Central Europe, was initiated.

In the beginning, pollutants and their various sources, in other words the symptomatic and diagnostic aspects, were given priority during the meetings. Soon, however, the agenda was enlarged by plant physiology results obtained from causal analyses or based on combination effects and methods of growth studies for damage assessment were developed.

On the basis of scientific findings from different countries (with different climate conditions), the research unit, at a conference in Ljubljana, Slovenia in 1978, agreed on a "Resolution on concentration limits of sulfurdioxide and hydrofluoride for forest protection", which has been included in legislation of numerous countries.

For some 25 years the research group has been studying possibilities for minimizing pollution in order to avoid or reduce damage, as well as possibilities of therapeutic measures. This has led to cooperation with other research disciplines, such as site and soil sciences, genetics and silviculture.

Since pollutants have changed with regard to both quality and quantity in the last few years, there has been an ongoing challenge to adapt existing methods and develop new ones to diagnose combination effects as well as to develop strategies to minimize damage.

Besides the "acid rain" problem, which may also cause wash–out of nutrients and soil modifications, the problem of increasing pollution by nitrogen, which may impair nutrient balance and thus physiological processes, is a topic of discussion in the exchanges of IUFRO Project Group P2.05–00 "Impacts of air pollution on forest ecosystems". The exchange of experience on these and other questions in connection with so–called "new forest damages" takes place through national monitoring networks which have been established in many countries. The methods on which these networks are based are currently being harmonized and standardized under the leadership of the Economic Commission for Europe (ECE). By means of the results obtained from intensified investigation, compared with earlier years, of the forest and air pollution problem, it will probably be possible in the future to adopt another international resolution on the limits for combination effects, thus contributing to a solution of the problem.

At the World Congress in Ljubljana in 1986 it was decided to establish a Task Force on "Air pollution and forest decline". It was to consist of members from all six IUFRO Divisions in order to allow interdisciplinary work on the subject. The Task Force issued a policy statement which was approved by the Montreal Congress in 1990.

Special Programme for developing Countries

It was during the 17th IUFRO World Congress in September, 1981 at Kyoto, Japan that IUFRO was first formally requested to undertake activity in aid of "strengthening research related to forest resources in developing countries". A recommendation put forward at that Congress, as part of the Congress Declaration, was the seed for collaborative global intervention in an area that was due to receive increasing attention through the 1980s.

By 1983, the seed had sprouted into IUFRO's Special Programme for Developing Countries (SPDC). With funding support from the World Bank and UNDP, and with in–kind support from the Government of Austria, the new Coordinator, Oscar Fugalli, was able to begin a small but meaningful programme. The funding fortunes of the SPDC rose and fell over the next several years but always there was enough to continue the programme and always the international community reaffirmed the need for such assistance.

Very early the following activity areas were established in response to needs identified by the developing countries:

- forestry research planning
- training in forestry research management
- training in forestry research methods
- facilitating information flows
- fostering twinning arrangements
- establishing a fund for forestry research training

During the next several years, much emphasis was placed on the holding of workshops in Africa, Asia and Latin America to identify regional research needs and priorities. From these workshops sprang numerous recommendations for research projects and networks in both establishment forestry and forest products utilization. Several have received donor support and have formed the backbone of collaborative regional research.

Emphasis was placed also on training programmes. A number of courses in statistics and research management were held. It quickly became clear, however, that the need for education programmes far exceeded the capability to hold formal courses even if, by the late 1980s, numerous international agencies were conducting courses for developing country personnel.

At the end of the decade, the SPDC changed its approach to training, favouring distance learning techniques. Self–teaching courses in basic statistics and land–use options were initiated and are nearing completion at the present time.

Much progress was made during the period in the development of information flows. In one particularly meaningful development the SPDC Information Bulletin for Developing Countries was established in the mid–1980s through special arrangement with CAB International, an arrangement that continues to this day.

In 1990, the founding Coordinator announced his retirement effective the end of that year. Lorne Riley, of Canada, assumed the position effective April, 1991. Since that time the established program has been continued, following the excellent lead of the 1980s, and has flourished through the receipt of new donor agency contributions. Some new direction has been articulated, to better ally the programme of the SPDC with the traditional programme of IUFRO, but general direction remains unaltered.

The goal of the SPDC continues to be to undertake, in collaboration with the international community, activities which will enhance the forest research capability of developing country scientists and institutions. Training and self–teaching programmes, information services and the fostering of inter–agency support mechanisms form the heart of the current programme.

Present and Future

With the focus on forestry and the environment by the United Nations Conference on Environment and Development (UNCED) or the Earth Summit, which was held in Rio de Janeiro Brazil, 1992, the issues on the environment and forestry will continue to be centerstage in international discussions.

IUFRO, as the umbrella body for forestry research and sciences in the world, needs to be sensitive to these issues and to plan programmes which will harness the resources of IUFRO towards supporting global initiatives in these fields. IUFRO must not only look at the issues of forestry and the environment but also focus on the changes in the global political scene and harness opportunities provided by expanding the IUFRO family to include the newly emerging countries as well as expand IUFRO in the developing world. IUFRO must change and adapt its structure to meet the long-term aims for forest research in the future. Forestry and the environment will play important roles in future political decisions and IUFRO will need to provide the technical and scientific base and foundation for such political decisions.

Problems

IUFRO needs to direct its scientific work and its organization towards the problems of the World's forests. These are, in particular:

- the uncontrolled destruction of tropical forests;
- the need for sustainable management of tropical forests;
- the replacement of natural and primary forests by plantations;
- the impoverishment of fauna, flora, and biodiversity of forests;
- air pollution, which is a serious threat to some forests of the world;
- climate change which could potentially change the forests of the world;
- the threat to forests by natural dangers (biotic and abiotic);
- the economic difficulties of many forest enterprises;
- the need for environmentally acceptable forest infrastructure and wood production;
- the contradictory nature of human demands on the forest;
- the changing attitudes of society towards nature and environment.

Tasks

IUFRO, as a worldwide research organization, is asked to offer to forestry and society, solutions for the conservation or restoration of the different types of forests in order to enable these essential natural resources to sustainably satisfy the manifold human needs.

The international forestry congresses organized in recent years by IUFRO and FAO, and the Earth Summit by UNEP (United Nations Environment Programme) have shown that most problems in forestry can be solved only through interdisciplinary or multidisciplinary cooperation. Therefore, IUFRO's activities in the future will have to be more project-oriented and not restricted to specialized disciplines.

Cooperation and information

As the problems of forest conservation are closely linked with the global problems of food supply and protection of the environment, IUFRO must foster and extend its contacts with other international scientific organizations. Closer cooperation is needed with international agricultural research agencies, in particular with the research institutes of CGIAR (Consultative Group on International Agricultural Research) such as ICRAF (International Center for Research in Agroforestry), and CIFOR (Center for International Forestry Research). In addition, cooperation with environment- and forestry-related organizations should be intensified, such as the FAO, UNESCO (United Nations Educational, Scientific and Cultural Organization), UNEP, ICSU (International Council of Scientific Unions), IUCN (International Union of Conservation of Nature), IUBS (International Union of Biological Sciences), ITTO (International Tropical Timber Organization), etc.

Exchange of and access to information has to be improved and should, in particular, be facilitated for scientists in developing countries. To reach this aim, it might be appropriate to restructure the IUFRO Regions, to establish IUFRO chapters, and to strengthen their ties with the member organizations and their scientific staff.

When IUFRO was founded, the basic idea was not to establish a union which carries out research work itself. Its strength and reputation resulted from the voluntary and gratuitous cooperation of the scientists, and from the support given by the member organizations for projects and targets of joint interest. This basic orientation will remain unchanged in the future. The great challenge, however, which forestry faces today, will demand new services from IUFRO.

To Think About

"Today the pressure is on, but we have a choice. Mankind can either lie down and give up or we can use all of our productive skills and knowledge to work for a better future."

Earl Butz

"There is a sufficiency in this world for Man's needs but not for Man's greed."

Mohandas Ghandi

"The past few years have made us aware, as we have never been before, of the depth of kinship among all living organisms. So life is akin and our kinship is much closer then we had ever imagined."

George Wald

"Perhaps the destiny of man is to have a short, but fiery, exciting and extravagant life rather than a long, uneventful and vegetative existence. Let other species - the amoebas for example - which have no spiritual ambitions, inherit an earth still bathed in plenty of sunshine."

Nicholas Georgescu-Roegen

"Look out, brothers, spring has come. Sun has embraced Earth. Soon we shall see the children of this love. Every seed, every animal has awakened, the same great force has given birth to us. Therefore we grant the same right to live on Earth to our fellow men and women, and to our friends, the animals."

Chief Sitting Bull

"The poet says the proper study of mankind is man. I say, study to forget all that, take wider views of the universe."

Henry David Thoreau

"Nature brings more than books."

Saint Bernard

"Imitate nature, hasten its work, such are the fundaments of silviculture."

K. Lorentz

"From the forest and wilderness come the tonics and barks which brace Mankind. Man cannot afford to be a naturalist, to look at nature directly ... He must look through and beyond her."

Henry David Thoreau

"Every wise forest director has to have evaluated the forest stands without losing time, to utilize them to the greatest possible extent, but still in a way that future generations will have at least as much benefit as the living generation."

G.L. Hartig, 1804

"All the resources of forest reserves are for use ... and where conflicting interests must be reconsidered the question must always be decided from the standpoint of the greatest good of the greatest number in the long term."

Gifford Pinchot

"I'm as much interested in beauty, in rugged scenery, and preservation of nature's great wonders (as anyone) ... But I want to point out ... that to my mind, beautiful farms, homes, industries, and a high standard of civilizations are equally desirable and inspiring."

US Senator Arthur V. Watkins, 1950

"If we want to make something really superb of this planet, there is nothing whatever that can stop us."

Shepard Mead

"It is a noteworthy and intriguing phenomenon of nature that visible form is not only something external and accidental but, rather, is in a far-reaching way closely bound to function and mode of life so that appearance and habit in the plant world quite often present a very striking expression of ecological condition."

Alfred Dengler

"With each step we are making forward, with each problem we solve, we discover not only new and unsolved problems, but we discover also the fact that, where we believe to have firm and safe ground beneath our feet, everything is actually unsafe and shaking."

Karl R. Popper

"Scientific criticism is justified only if it provides a truth in exchange for an error."

Santiago Ramón y Cajal

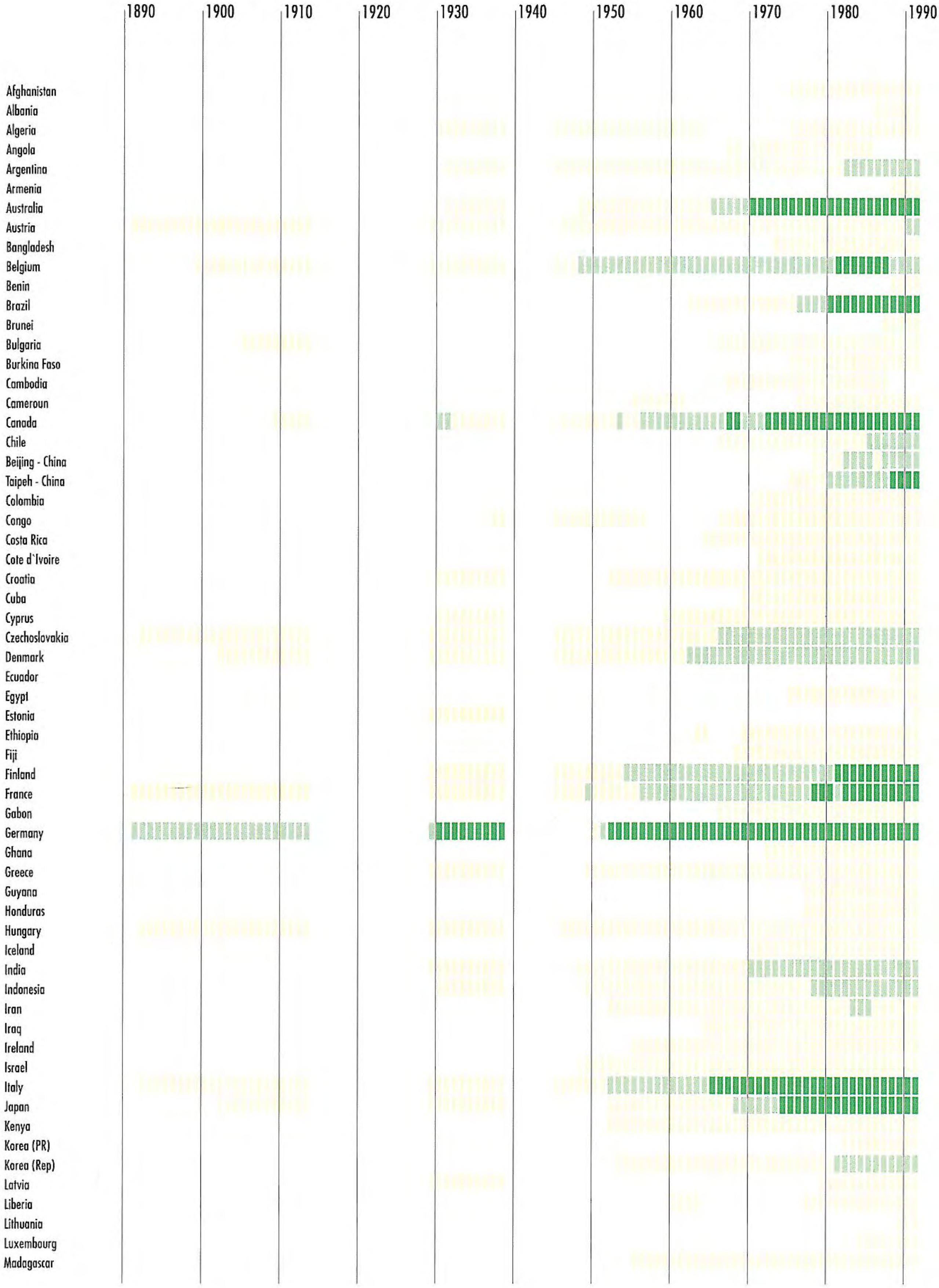
"All our endeavours, all dramatic fights between old and new views are borne by the eternal striving for knowledge, the unshakable belief in the harmony of the universe, which becomes even more firm the more obstacles tower up against us."

Albert Einstein

"Creativity comes from looking for the unexpected and stepping outside your own experience."

Masaru Ibuka

Membership


1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
Afghanistan
Albania
Algeria
Angola
Argentina
Armenia
Australia
Austria
Bangladesh
Belgium
Benin
Brazil
Brunei
Bulgaria
Burkina Faso
Cambodia
Cameroun
Canada
Chile
Beijing - China
Taipeh - China
Colombia
Congo
Costa Rica
Cote d'Ivoire
Croatia
Cuba
Cyprus
Czechoslovakia
Denmark
Ecuador
Egypt
Estonia
Ethiopia
Fiji
Finland
France
Gabon
Germany
Ghana
Greece
Guyana
Honduras
Hungary
Iceland
India
Indonesia
Iran
Iraq
Ireland
Israel
Italy
Japan
Kenya
Korea (PR)
Korea (Rep)
Latvia
Liberia
Lithuania
Luxembourg
Madagascar

1-4 Members
5-9 Members
≥ 10 Members

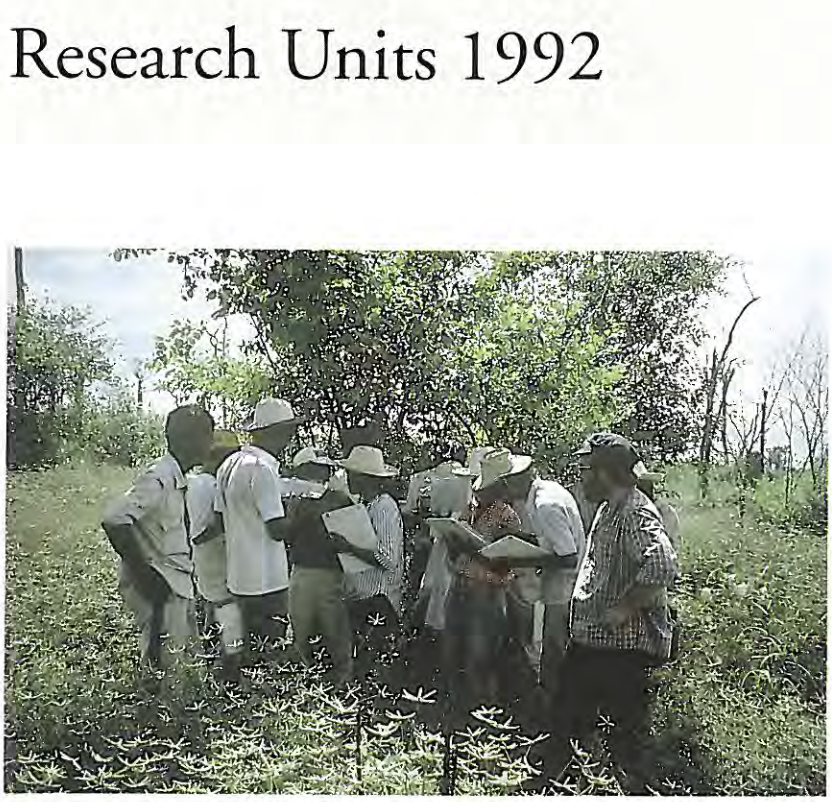
1892-1914: Members & observers
since 1930: Member organizations without subsidiaries
Member organizations on the territory of the present states; 30 June 1992

Congresses & Presidents

No.	Date	Place	Statistics	President
*	1892 17 August Foundation Meeting	Germany Eberswalde	Participants: 12 countries: 3 papers: • meetings: 1 excursions: •	*Representatives of the forest experiment stations:* F. Krutina, C. Kast, L.W. Horn, K. Ney, K. Wimmenauer, B. Danckelmann, A. Schwappach, K. Fricke, T. Lorey, J. Friederich, J. Lorenz-Liburnau, A. Bühler
1	1893 11 – 17 September	Austria Vienna	Participants: 17 countries: 5 papers: 5 meetings: 2 excursions: 4	 Josef Friedrich Austria 1892–1893
2	1896 19 – 24 September	Germany Braunschweig	Participants: 16 countries: 5 papers: 6 meetings: 2 excursions: 5	 Bernhard Danckelmann Germany 1894–1896
3	1900 4 – 11 September	Switzerland Zürich, Bern	Participants: 23 countries: 7 papers: 5 meetings: 2 excursions: 7	 Conrad Bourgeois Switzerland 1897–1900
4	1903 31 August – 5 September	Austria Vienna	Participants: 35 countries: 10 papers: 8 meetings: 2 excursions: 4	 Josef Friedrich Austria 1901–1903
5	1906 8 – 18 September	Germany Stuttgart	Participants: 40 countries: 14 papers: 8 meetings: 4 excursions: 8	 Anton Bühler Germany 1904–1906
6	1910 10 – 22 September	Belgium Spaa, Brussels	Participants: 60 countries: 17 papers: 10 meetings: 4 excursions: 5	 N.I. Crahay Belgium 1907–1910
–	1914 September	Hungary Budapest	completely organized, cancelled due to World War I	 Jenö Vadas Hungary 1911–1914
7	1929 14 – 27 July	Sweden Stockholm	Participants: 205 countries: 31 papers: 105 meetings: 5 excursions: 3	 Henrik Hesselmann Sweden 1929
8	1932 4 – 11 September	France Nancy	Participants: 89 countries: 33 papers: 64 meetings: 7 excursions: 19	 Philibert Guinier France 1929 – 1932
9	1936 25 August – 8 September	Hungary Budapest	Participants: 135 countries: 23 papers: 84 meetings: 7 excursions: 10	 Gyula Roth Hungary 1933–1936

10	1948 5 – 11 September	Switzerland Zürich	Participants: countries: papers: meetings: excursions:	99 17 4 6 2		Erich Lönnroth Finland 1937–1948
11	1953 22 – 26 September	Italy Rome	Participants: countries: papers: meetings: excursions:	154 20 123 3 1		Hans Burger Switzerland 1949–1953
12	1956 7 – 14 July	United Kingdom Oxford	Participants: countries: papers: meetings: excursions:	242 36 160 4 7		Aldo Pavari Italy 1954–1956
13	1961 10 – 16 September	Austria Vienna	Participants: countries: papers: meetings: excursions:	410 39 191 5 3		James McDonald United Kingdom 1957–1961
14	1967 3 – 9 September	Germany Munich	Participants: countries: papers: meetings: excursions:	968 53 456 5 10		Julius Speer Germany 1962–1967
15	1971 14 – 20 March "Research's Role in the Intensification of Forestry Practices and Activities"	USA Gainesville	Participants: countries: papers: meetings: excursions:	771 57 424 5 4		George M. Jemison USA 1968–1971
16	1976 20 – 26 June 1992 "Forestry in a World of Limited Resources"	Norway Oslo	Participants: countries: papers/posters: meetings: excursions:	1065 67 712 4 15		Ivar Samset Norway 1972–1976
17	1981 7 – 12 September "Research Today for Tomorrow's Forests"	Japan Kyoto	Participants: countries: papers/posters: meetings: excursions:	1300 73 800 5 14		Walter Liese Germany 1977–1981
18	1986 7 – 21 September "Forest Science Serving Society"	Yugoslavia Ljubljana	Participants: countries: papers/posters: meetings: excursions:	1925 72 702 5 16		Dusan Mlinsek Yugoslavia/Slovenia 1982–1986
19	1990 5 – 11 August "Science in Forestry: IUFRO's Second Century"	Canada Montreal	Participants: countries: papers/posters: meetings: excursions:	2.006 91 1.350 5 14		Robert Buckman USA 1987–1990
100 Years	1992 31 August – 4 September "100 Years of IUFRO"	Germany Berlin – Eberswalde	Participants: countries: papers/posters: meetings: excursions:	. . . .		M.N. Salleh Malaysia 1991–1995

Research Units 1992



D1.00–00 Forest Environment and Silviculture

S1.01–00 Ecosystems
S1.01–01 Virgin Forests
S1.01–05 Landscape ecology
S1.01–06 Tropical and subtropical forest ecosystems
S1.01–08 Ecology and silviculture of European silver fir
S1.01–09 Forest dynamics
S1.02–00 Site
S1.02–01 Fertilization of forest land
S1.02–05 Recycling of wastes on forest lands
S1.02–08 Foliar analysis
S1.02–09 Maintenance and improvement of plantation productivity
S1.03–00 Environmental influences
S1.03–02 Forest hydrology
S1.04–00 Natural disasters
S1.04–01 Torrent erosion and control
S1.04–02 Snow and avalanches
S1.04–03 Land slides and stabilization
S1.04–04 Erosion control by watershed management
S1.05–00 Stand establishment, treatment and amelioration
S1.05–01 Peatland forestry
S1.05–03 Treatment of young stands
S1.05–04 Characterization of plant material
S1.05–05 The European Norway spruce thinning experiment
S1.05–06 Multiple–use silviculture
S1.05–08 Natural stand regeneration
S1.05–09 Treatment and conversion of coppice stands
S1.05–10 Monospecific coppice stands in short rotation
S1.05–11 Intensification of cedar silviculture
S1.05–12 Northern forest silviculture and management
S1.05–13 Shelterbelts
S1.02–06 Site classification and evaluation
S1.05–14 Silvicultural problems in mountain regions
S1.07–00 Tropical silviculture
S1.07–05 Natural regeneration of tropical rain forests
S1.07–08 Silviculture of mangrove forests
S1.07–09 Silviculture in Latin America
S1.07–13 Silviculture of plantations in Asia and Pacific Region
S1.07–14 Silviculture of plantations in Africa
S1.07–15 Silviculture and management in arid and semi–arid regions
S1.07–16 Rattans
S1.07–17 Biology and silviculture of dipterocarps
S1.08–00 Wildlife and its habitats
S1.08–01 Wildlife habitat evaluation
S1.08–02 Wildlife management
S1.08–03 Human influences on wildlife
S1.09–00 Forest fire research
S1.02–10 Soil chemistry
S1.03–01 Forest meteorology and climatology
S1.09–01 Prescribed burning research
S1.09–02 Fire prevention research
S1.09–03 Fire fighting methods and equipment research
S1.09–04 International fire glossary
P1.06–00 Improvement and silviculture of oaks
P1.07–00 Ecology of subalpine zones
P1.09–00 Integrated research in biomass for energy
P1.10–00 Improvement and silviculture of beech
P1.11–00 Mediterranean shrub ecosystems
P1.13–00 Forest weed management
P1.14–00 Unevenaged silviculture
P1.15–00 Agroforestry

D2.00–00 Forest Plants and Forest Protection

S2.01–00 Physiology
S2.01–05 Reproductive process
S2.01–08 World directory of tree physiologists
S2.01–11 Shoot growth physiology
S2.01–12 Canopy processes
S2.01–13 Root physiology and symbiosis
S2.01–14 Cold and drought hardiness
S2.01–15 Whole plant physiology
S2.02–00 Provenances, breeding and genetic resources
S2.02–02 Identification and conservation of genetic resources
S2.02–05 Douglas–fir provenances and breeding
S2.02–06 Contorta pine provenances and breeding
S2.02–07 Larch provenaces and breeding
S2.02–08 Tropical species provenances and breeding
S2.02–09 Eucalypt provenances and breeding
S2.02–10 Poplar provenances and breeding
S2.02–11 Norway spruce provenances and breeding
S2.02–12 Sitka spruce provenances and breeding
S2.02–13 Mediterranean conifer provenances and breeding
S2.02–14 Abies provenances and breeding
S2.02–15 Provenances and breeding of five–needle pines
S2.02–16 Seed orchards
S2.02–17 World directory of forest geneticists and tree breeders
S2.02–18 Scots pine provenances and breeding
S2.02–19 Pinus radiata provenances and breeding
S2.02–20 Breeding southern pines
S2.02–21 Legislation of forest reproductive material
S2.02–22 Genetics of Quercus
S2.04–00 Genetics
S2.04–01 Population and ecological genetics
S2.04–02 Breeding theory and progeny testing
S2.04–05 Biochemical genetics
S2.04–06 Molecular genetics of forest trees
S2.04–07 Somatic cell genetics
S2.04–08 Cytogenetics
S2.05–00 Genetic resistance to insects and diseases
S2.05–01 Resistance of pines to blister rust
S2.05–02 Resistance of elms to diseases and insects
S2.05–04 Resistance of pines to Melampsora pinitorqua
S2.05–06 Mechanisms of plant resistance
S2.06–00 Pathology
S2.06–01 Root and butt rot
S2.06–02 Canker and shoot blight of conifers
S2.06–04 Foliage diseases
S2.06–05 Mistletoes
S2.06–06 Vascular wilt diseases
S2.06–09 Mycoplasma and virus diseases of forest trees
S2.06–10 Rusts of pines
S2.06–14 Complex diseases
S2.06–15 Diseases of tropical plantations
S2.07–00 Entomology
S2.07–01 Cone and seed insects
S2.07–03 Insects affecting reforestation
S2.07–05 Integrated control of scolytid bark beetles
S2.07–06 Population dynamics of forest insects
S2.07–07 Protection of forest in the tropics
S2.07–08 Forest gall midges
S2.07–09 Diseases and insects in nurseries
S2.07–10 Forest protection in Northeast Asia
P2.02–00 Productivity of plantation forestry with fast–growing trees
P2.02–01 Productivity of eucalypts
P2.02–02 Productivity of conifers
P2.02–04 Productivity of nitrogen fixing trees
P2.04–00 Seed problems
P2.05–00 Impacts of air pollution on forest ecosystems
P2.05–01 Diagnosis, monitoring and evaluation
P2.05–03 Biochemical and physiological aspects
P2.05–04 Soil organisms, rhizosphere and nutrient uptake
P2.05–05 Genetic aspects of air pollution
P2.05–07 Silviculture in polluted areas
P2.05–08 Wood structure and quality in polluted areas
P2.05–09 Atmospheric pollution and forest policy

D3.00–00 Forest Operations and Techniques

S3.02–00 Operational methods in the establishment and treatment of stands
S3.02–01 Stand establishment operations
S3.02–02 Stand treatment operations
S3.02–03 Nursery operations
S3.04–00 Operational planning and control; work study
S3.04–01 Planning and control
S3.04–02 Work study, payment, labour productivity
S3.05–00 Forest operations in the tropics
S3.06–00 Forest operations under mountaineous conditions

S3.06–01 Accessibility of mountain forests
S3.06–02 Harvesting in mountain forests
P3.03–00 Ergonomics
P3.03–01 Physical work environment
P3.03–02 Psycho–social problems
P3.03–03 Health and safety
P3.03–04 Ergonomics in the timber industry
P3.04–00 Small–scale forestry
P3.06–00 Economics and harvesting of thinnings
P3.08–01 Site impact caused by forestry operations
P3.06–01 Thinning and mechanization
P3.06–02 Economics of spacing and thinning
P3.07–00 Harvesting, wood delivery and utilization
P3.07–01 Harvesting and timber quality
P3.07–02 Harvesting and utilization of tree foliage
P3.07–03 Centralized tree processing
P3.07–04 Harvesting and forest energy
P3.08–03 Methods and techniques for site protection and improvement
P3.08–02 Forest operations on sensitive sites
P3.07–05 Wood delivery
P3.08–00 Forest operations and environmental protection

D4.00–00 Inventory, Growth, Yield, Quantitative and Management Sciences

S4.01–00 Mensuration, growth and yield
S4.01–03 Design, performance and evaluation of experiments
S4.01–04 Growth models for tree and stand simulation
S4.01–06 Instruments and methods in forest mensuration
S4.01–07 Design, performance and evaluation of models for forest stand dynamics
S4.02–00 Forest resource inventory and monitoring
S4.02–01 Resource data in the tropics
S4.02–02 Multipurpose inventories
S4.02–03 Forest inventory on successive occasions
S4.02–04 Geographic and management information systems
S4.02–05 Remote sensing and global forest monitoring
S4.02–06 Resource data in the boreal regions
S4.04–00 Forest management planning and managerial economics
S4.04–01 Inventory of stands
S4.04–02 Managerial economics
S4.04–03 Forest management planning methods
S4.04–04 Economic planning systems for forest management
S4.04–06 Management planning and managerial economics in short rotation timber plantations
S4.11–00 Statistical methods, mathematics and computers
S4.11–01 Statistical methods
S4.11–02 Mathematics
S4.11–03 Computers
S4.12–00 Remote sensing technology

D5.00–00 Forest Products

S5.01–00 Wood quality
S5.01–01 Formation of wood
S5.01–02 Natural variations in wood quality
S5.01–04 Biological improvement of wood properties
S5.01–05 Wood properties desired by end–users
S5.02–00 Timber engineering
S5.03–00 Wood protection
S5.03–02 Protection of particle board and composite products
S5.03–03 Wood in storage
S5.03–04 Protection from fire
S5.03–05 Biodeterioration
S5.04–06 Wood drying
S5.03–07 Preservation and processes
S5.03–08 Natural durability
S5.04–00 Wood processing
S5.04–07 Adhesives and wood gluing
S5.04–08 Milling and machining
S5.04–10 Production systematics
S5.04–11 Wood–based composite products
P5.01–00 Properties and utilization of tropical woods
P5.03–00 Energy and chemicals from forest biomass
P5.04–00 Production and utilization of bamboo and related species
P5.05–00 Tree ring analysis
P5.06–00 Forest products marketing
P5.07–00 Non–wood forest products
P5.07–01 Environmental aspects of maple syrup production
P5.07–02 Medicinal and aromatic plants

D6.00–00 Social, Economic, Information, and Policy Sciences

S6.01–00 Forest recreation, landscape and nature conservation
S6.01–02 Landscape management and environment
S6.01–04 Social studies
S6.01–05 Application of recreation and landscape research to policy and management
S6.01–06 Monitoring and evaluation of impacts on environment
S6.03–00 Information systems and terminology
S6.06–00 Management of forest research
S6.06–02 Philosophy and methods of forest research
S6.06–03 Extension
S6.07–00 Forest history
S6.07–01 Tropical forest history
S6.07–03 Historical timber trade
S6.11–00 Social and economic aspects of forestry
S6.11–01 Economic and social aspects of forestry in developing countries
S6.11–02 Forestry and rural development in industrialized countries
S6.11–03 Economics of integrated watershed management
S6.11–04 Economic evaluation of multifunctional forestry
S6.11–05 Economic evaluation of forest damages
S6.12–00 Forest policy and forestry administration
S6.12–01 Analysis and evaluation of forestry policies and programs
S6.12–02 Forest institutions and forestry administration
S6.12–03 Integrated land use and forest policy
S6.12–04 Policy aspects of forestry development
S6.13–00 Forest law and environmental legislation
S6.14–00 Urban forestry
P6.01–00 Forest Decimal Classification
P6.11–00 Forest sector analysis
P6.11–01 Supply and demand of roundwood and forest industry products
P6.12–00 Ecological economic

Autographs

Editorial

Owner and Editorial Office:
IUFRO - International Union of
Forestry Research Organizations
Secretariat
Seckendorff-Gudent-Weg 8
A-1131 Vienna, Austria
Tel: +43-1-82 01 51 (+43-1-877 01 51 0)*
Fax: +43-1-82 93 55 (+43-1-877 93 55)

Editor: H. Feichter
Translations: B. Wibmer
Responsible for the contents: H. Schmutzenhofer
Printed by: Druckerei Gablitz, Austria

Acknowledgements

We wish to thank all those who have helped us to issue this brochure by contributing texts, photographs, corrections, and advice.

Illustration credits

A.Ahti:10; R. Buckmann: 17,20,21; Daiichi Planning Centre: 19; Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft: 3,5,11; Forstliche Bundesversuchsanstalt Wien: 2,4,6,9,11,13,16; Fotothek Dresden: 7; O. Holzwieser : 17,25; H.F. Joachim: 2; K. Johann: 6; W. Kilian: 8; H.Krempl: 19; H. Kriebel: 23; W. Liese: 14; K. Lindh, 27; R. Morandini: 8; T.Payne: 12; J.Pollanschütz: 24; L. Riley: 16; R. Schlaepfer: 34; H. Schmutzenhofer: 9,18,19,26; Stadtarchiv Eberswalde: 3; B. Youngs: 25

Printed with financial support of the German Federal Ministry for Economic Cooperation (BMZ) through the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH.